Solid waste disposal of

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Current status

Why is controlled waste disposal important?
Stages in the SWM system

### Waste disposal: options

#### Non-engineered disposal
- Systems without any control, or with only slight or moderate controls
- In place for many years
- High environmental and health costs

#### Sanitary landfilling
- Fully engineered disposal option
- Wastes spread, compacted and covered
- Land carefully engineered before use
## Stages in the SWM system

### Common disposal methods in DCs

<table>
<thead>
<tr>
<th>Disposal practice</th>
<th>Primary collection</th>
<th>Secondary collection</th>
<th>Designated places</th>
<th>Operation at the site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste discarded at source</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Uncontrolled local disposal</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Uncontrolled city disposal</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Semi-controlled disposal</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Controlled disposal</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>limited</td>
</tr>
<tr>
<td>Fully-engineered disposal</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
What is a landfill?

It is not just a place where waste is disposed of, but it is a technological plant designed, realized and managed to obtain a minimization of negative effects.

Sanitary landfilling is a fully engineered disposal option that avoids the harmful effects of uncontrolled dumping by spreading, compacting and covering the waste on land that has been carefully engineered before use.

4 basic conditions:
- full or partial hydrogeological isolation
- formal engineering preparations
- permanent control
- planned waste emplacement and covering

Source: Rushbrook and Pugh, 1999
Types of landfills

Hill shaped
- No digging costs
- High visual impact
- Facilitated flowing of leachate and storm water

On a slope
- Low stability of waste
- Facilitated flowing of leachate and storm water

In a depression site
- Reduced visual impact
- Difficult drainage of leachate and storm water
Inappropriate areas:

- Closer to populated area
- Drinking water protection areas (wells, superficial basins, rivers)
- Unstable ground
- Areas subjects to overflowing

Preferable areas (positive areas)

- Soil with low permeability
- Possibility of continous gravity drainage for leachate from waste
- Presence of access roads
A final cover allows to:
• limit infiltration of storm water in the waste (reducing leachate production)
• recover the area, reintegrate it into the landscape, and prepare the area to a future use

How to limit the production of leachate?
• Modelling the slope in order to increase water runoff
  ⇒ slope > 5-10%
• Placing an impermeable layer (compacted clay > 30 cm) in order to limit infiltration of rain water into the waste
Construction in cells

- reduce capital investment costs
- lower amount of leachate
Control of leachate

Details of the leachate storage ditches

(Jamarillo, 2008)
Gaseous emissions

Construction of gas drains or vents

(Jamarillo, 2008)
Gaseous emissions

(Layout of vents in the landfill)
Types of landfill

Mechanized sanitary:
Large cities and populations (>40 tons daily)
It requires technical planning, control of operations, large investments, heavy equipment dedicated

Semi-mechanized:
Towns (16-40 tons daily)
Use heavy machinery to support the manual labour (garbage compaction and banks stabilization)

Manual:
Small communities (<16 tons daily)
Compacting and confining of waste carried out by a team of laborers using hand tools

Adapted from Jaramillo (2003)
Semi-mechanized sanitary landfills

1. Waste download

2. Waste spreading

30 cm
Semi-mechanized sanitary landfills
3. Compaction

At least 5 times

4. Waste windrow formation

Embankment 2 m
Semi-mechanized sanitary landfills

4. Waste windrow formation
5. Daily earth coverage

Every day put a 10 cm layer of earth over the waste windrow!!

At least 5 times
Manual sanitary landfills

5. Earth coverage compaction

Covering MSW with earth

Compaction of the first finished cell with roller and hand tamper
Main interventions for the construction or rehabilitation of 7 disposal sites

- Levellement of access roads
- Construction of a simplified system for collection of rainwater and leachate (draining channels + evaporation basin)
- Building of embankments
- Shaping of the bed of the landfill
- Building of warehouses
Semi-mechanized sanitary landfills: a case study from Somaliland

Boroma disposal site

Before

After
Semi-mechanized sanitary landfills: a case study from Somaliland

Boroma disposal site
Semi-aerobic landfill

- Waste in aerobic conditions: bacteria activity converts biodegradable matter in H2O and humus
- Perforated pipes to collect leachate and supply air into the waste
- Stack effect due to heat produced by bio-degradation exothermic reactions (50-70°C)
Semi-aerobic landfill

The aerobic degradation of MSW within a landfill can:
1. significantly increase the rate of waste decomposition and settlement,
2. decrease the production of methane gas and odours,
3. reduce the level of toxic organics in the leachate.
Vertical pipes have to be installed in order to increase the aerated portions of wastes
Advantages of Semi-aerobic Landfill Type

- Leachate is discharged as soon as it is collected - reduce the seepage of leachate
- Fresh air is brought in from the pipes - enhance waste stabilisation, improve leachate quality and reduce the cost of final treatment of leachate
- Release gas from gas ventilation pipes - reduce gas pressure and the chance of gas explosion
- Compaction of waste - reduce land consumption
- Enhance waste stabilisation - less time requires for the reuse of completed landfills (for vegetation, open space, parks, recreation, school, etc.)
- Reduce of CH4 and increase of CO2 helps preventing the global warming
- Cost-effective as initial investment and maintenance cost of Semi-aerobic is lower than that of Aerobic type of landfill
Semi-aerobic Landfill site

Local materials could be used to realize leachate collection and gas venting pipe

From Dr. Matsufuji. Fukuoka Univ. «Semi Aerobic Landfill Site story» «Mizu» Jan&Feb 1998)
Management of semi-aerobic landfills

- Wastes are disposed in layers with a thickness not more than 1 m
- Daily cover with soil (not clay) > 15 cm to avoid:
  - Bad smell
  - Vermins and pests
  - Scattering of light waste by wind
- A new layer has to be disposed when the aerobic fermentation in the layer below has ended (a few months)
- Soil final cover > 50 cm
Further reading


Ali S. M. (2010b): “Key Issues and Approaches in Solid Waste Management in Developing Countries”, Series of Workshops, CeTAmb, University of Brescia, September 2010, available on http://www.ing.unibs.it/~cetamb/seminari


Jaramillo J. (2003): “Guidelines for the design, construction and operation of manual sanitary landfills - A solution for the final disposal of municipal solid wastes in small communities”, Pan American Center for Sanitary Engineering and Environmental Sciences, Lima


Further reading


Further reading


WEDC (2010): “Solid Waste Management”, Handouts from postgraduate module on solid waste management, Loughborough University, Loughborough


